



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/052,688	03/31/1998	LAWRENCE A. CLEVINGER	98P7476US	9416

7590

10/22/2002

SIEMENS CORPORATION
INTELLECTUAL PROPERTY DEPARTMENT
186 WOOD AVENUE SOUTH
ISELIN, NJ 08830

EXAMINER

PERALTA, GINETTE

ART UNIT PAPER NUMBER

2814

DATE MAILED: 10/22/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/052,688

Applicant(s)

CLEVENGER ET AL.

Examiner

Ginette Peralta

Art Unit

2814

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 09 July 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-27 is/are pending in the application.
- 4a) Of the above claim(s) 6 and 16-27 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-5, 7-15 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____

- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-5, and 7-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Teong (U. S. Pat. 5,693,563) in view of Hegde et al. (U. S. Pat. 6,136,682), as previously applied.

Teong teaches in Fig. 7 an integrated circuit comprising a dielectric layer formed over a substrate, a first damascene structure in the dielectric layer, the first damascene structure comprising a bottom surface and first and second sidewalls, a first conductor (18) located in the damascene structure, the conductor comprising a conductive material, a first liner layer (7) lining the bottom surface and sidewalls of the first damascene structure and encapsulating (11) the first conductor (18) by contacting a top surface of the first conductor, the liner layer comprising titanium nitride, a second damascene structure in the dielectric layer, the second damascene structure comprising a bottom surface and second sidewalls and disposed above the first damascene structure, a second conductor (28) located in the damascene structure, the conductor

Art Unit: 2814

comprising a conductive material, a second liner layer (17) lining the bottom surface and sidewalls of the second damascene structure, and wherein the second liner layer is in contact with the first liner layer, wherein the material of the liner is titanium nitride, wherein the liner layer has a thickness between about 500 and 2000 Å, the structure further comprising a subliner (4,14) of titanium with a thickness between about 500 and 1500 Å, wherein the conductive material comprises copper, wherein the cavity that is filled with the conductor has a depth of between 2000 and 6000 Å.

With respect to claim 9, the limitation of "N₂/H₂ plasma treated titanium nitride" is directed to a process for forming an amorphous titanium nitride layer. "Product by process" limitations in claims drawn to structure are directed to the product, and not the process by which the product was obtained.

With respect to claims 8 and 15, since applicants failed to show a critical nature of the claimed thickness pertaining unexpected results, further noting that it is well known and desirable in the art that to some extent scaling for higher density requires thinner device layers, it would have been obvious to one of ordinary skill in the art to vary the thickness of the titanium nitride layer and the aluminum layer.

Teong teaches all the limitations in the claims with the exception of disclosing a liner layer of an amorphous character that would impart a random grain orientation to the conductive material.

Hegde et al. teaches an integrated circuit comprising a dielectric layer formed over a substrate, a first damascene structure in the dielectric layer, the first damascene

structure comprising a bottom surface and first and second sidewalls, a first conductor located in the damascene structure, a first liner layer lining the bottom surface and sidewalls of the first damascene structure, the liner layer being amorphous and thus imparting a random grain orientation in the conductive material of the first conductor to improve electromigration lifetime of the first conductor (col. 3, ll. 1-24), wherein the liner layer comprises tantalum nitride and titanium nitride, and the thickness of the liner layer is between about 0 to 400Å, and the structure comprising a subliner.

Thus, it would have been obvious to one of ordinary skill in the art to use an amorphous titanium nitride layer in the invention of Teong et al. for the disclosed intended purpose of Hegde et al. of obtaining an improved copper barrier layer.

Furthermore, it would have been within the scope of one of ordinary skill in the art to form the liner layer of the second conductor to encapsulate the conductor as Teong et al. teaches the feature in the first conductor and the repetition of a previously taught structure is not a patentable feature as it would not yield any unexpected results.

Response to Arguments

3. Applicant's arguments filed 7/9/02 have been fully considered but they are not persuasive.

With regards to applicant's argument that Hegde et al. teaches that it is the combination of titanium nitride on top of tantalum nitride that provides an improved barrier layer, it is noted that Hegde et al. teaches in Col. 3, ll. 1-5, that "due to the presence of the tantalum nitride, the titanium nitride, which usually deposits in a

crystalline form, will mimic the amorphous tantalum nitride structure and thus be deposited in an amorphous state which improves barrier properties", thus it is noted that the barrier is improved because of the amorphous state of the layers and not because of the presence of tantalum nitride, furthermore, the claim language does not preclude the liner layer from being a combination of layers, and the use of dual or triple liner layers is well known in the art and highly applied in interconnect structures.

With regards to applicant's argument that neither Teong or Hegde is disclosed or suggested the encapsulation of the conductor with the liner layer, it is noted that Teong discloses in Figs. 6 and 7 the use of a liner layer that encapsulates the conductor 8, furthermore, the repetition of this structure on conductor 28 since it has been held that the mere duplication of the essential working parts of a device involves only routine skill in the art. *St. Regis Paper Co. v. Bemis Co.*, 193 USPQ 8.

Conclusion

4. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and

Art Unit: 2814


any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ginette Peralta whose telephone number is (703)305-7722. The examiner can normally be reached on Monday to Friday 8:00 AM- 5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on (703)306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are (703)308-7722 for regular communications and (703)308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703)308-0956.

GP
October 17, 2002


Olik Chaudhuri
Supervisor
Technology Center